plain the propagative activity that often makes itself apparent even in highly specialized organs, as the leaf of the Begonia, by the laws of reversion, and vegetative propagation would become atavistic in its implication. Entirely apart, however, from speculations like these it seems well to insist upon the close examination of even so common a term as the word "spore," for any increase in exactness is an impetus to thought that should not be underestimated.

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The range of variation in species of Erythronium.

M. E. MEADS.

WITH PLATE XI.

About a year ago while working upon plant variations some interesting variations of *Erythronium Americanum* were found of which I could find no record. During the past two years I have made a careful study of the two species, *E. Americanum* and *E. albidum*, with the view of ascertaining the limits of their variations. Over four hundred specimens have been examined, and the results seem to warrant publication.

According to the best authorities the principal specific differences of the two species lie in the stigmas and color of perianth; E. Americanum having an entire, club-shaped stigma, while the stigma of E. albidum is three-cleft and spreading. In the fifth plant of E. Americanum that I examined the stigmas were not united; they were 3.2^{mm} in length with a spread of 3^{mm}, and of fifty-three plants of which I took careful measurements, only seven had the stigmas united, the length of the stigmas ranging from 1.3^{mm} to 7.1^{mm}. As may be seen in figs. 1–3, the stigmas of E. Americanum are not recurved; fig. 10, on a much larger scale, shows this more clearly and also shows the contracted appearance just below the apex; measurements for the spread of the stigma were taken above this at line *a;* these measurements range from 1.3^{mm} to 3.6^{mm}.

Owing to the curve of the stigma of E. albidum, it was impossible to take accurate measurements of the length; there is, however, a considerable range, although not as great as in E. Americanum. The spread of the stigma of this species

figs. 5–7, in twenty plants from which I took measurements, varies from 1.1^{mm} to 4.6^{mm}. Fig. 11 represents diagrammatically the upper surface of a stigma, line *bc* showing where these measurements were taken. Sometimes the stigma has the contracted appearance of E. Americanum, fig. 7; in such cases the plant can only be identified by the color of the perianth.

A distinction has been made between the leaves of E. Americanum and E. albidum, regarding shape, size and markings. So far as my observations go, this is a distinction without a difference. I have found patches of E. Americanum where the leaves were entirely without blotches, and the leaves of E. albidum are frequently as deeply mottled as are ever found in E. Americanum. The shape in both species varies from broadly oval to nearly linear, and the size varies as greatly.

Another species, *E. mesochoreum*, has recently been claimed for Kansas. The noteworthy differences between E. albidum and E. mesochoreum, as given, are, briefly:

"*E. albidum* Nutt.—Leaves lance-elliptical, more or less mottled with purple or light green blotches; cross section of ovary blunt, triangular, with sides concave because of narrowed partitions; sterile forms propagated by paired underground runners which develop new corms at their extremities.

"*E. mesochoreum* Knerr.—Leaves much longer and more narrow, almost linear, never mottled; cross section of ovary bluntly triangular, with sides convex because of wider partitions; new corms developed at the base within the old; no runners."

In a dozen leaves of E. albidum of which I took measurements the length was from four to nineteen times greater than breadth; some of the leaves being nearly linear. According to Torrey the leaves of E. albidum are not marked. This spring I examined about a dozen plants of E. mesochoreum, kindly furnished me by Mr. Knerr. Among them was one plant, otherwise answering perfectly to the description of E. mesochoreum, with leaves deeply mottled with purple. Fig. 12 shows, on an enlarged scale, a cross section of an ovary of E. mesochoreum. It may not be a typical form, but answers the description the best of any in the material furnished me. While the sides of the ovary of E. albidum are usually concave, they are sometimes convex, figs. 13 and 14. I have examined about twenty corms of E. albidum,

and fig. 9 is a good type of what I have found in various stages of development in nearly all of them. This is also commonly found in E. Americanum. The following note from BOTANICAL GAZETTE, II (June, 1877) may throw further light on this species.

"The normal E. albidum from Illinois to western Iowa, noted for spotted broad leaves and very recurved petals, is confined to groves; while a much smaller form from western Iowa to Kansas confined to prairies has narrow leaves, never spotted, petals never recurved, not half the height of the former. The difference is doubtless due to soil and locality.—R. Burgess, Ames, Iowa."

The above seems to indicate that E. mesochoreum instead of being a true species is but a variety marked by certain variations constant in it, and found, but not constant, in E. albidum.

I took careful measurements of every part of the flower of E. Americanum and E. albidum, and plotted the curves according to the method used by Alfred Russell Wallace in animal variations. Comparing the results of thirty-four specimens of each, we find the length and width of the petal, length of stamens and ovary, and length and spread of stigma are closely correlated in E. Americanum. In E. albidum the variations of the length of the petals and ovary are more loosely correlated. The other parts vary independently, sometimes seeming to follow the variations of these, and again when a decided variation in some direction is looked for, varying not at all or even decidedly in the opposite direction. The general variations of the two plants are in an opposite direction, toward each other. This is shown by comparing the mean measurements of the different parts and the variations from that, in the following manner:

Length of	*Species.*	*Mean.*	*Number above the mean*	*Number below the mean*
Petal	Americanum	32.65mm	19	15
Petal	albidum	34.45mm	15	19
Style	Americanum	10.25mm	23	11
Style	albidum	11.1mm	11	23
Ovary	Americanum	10mm	5	29
Ovary	albidum	8.25mm	19	15

In all the plants of E. Americanum that I have examined I have found in the stamens a tendency to heteromorphism, fig. 8. In fifty-three plants from which I took measurements the mean difference was 2.65^{mm}, the greatest difference I have recorded is 4.5^{mm}, but I am convinced that some of which I was unable to get measurements had a greater difference even than this. Designating the longer set as *A* and the shorter as *B*, and comparing as above, we have:

Set.	*Mean.*	*Above mean.*	*Below mean.*
A	21.15^{mm}	27	26
B	18.5^{mm}	25	27

showing that the ratio of the two sets of stamens is nearly constant, with a very slight tendency to increased difference in length. This tendency to heteromorphism of stamens is also found in E. albidum, but is not so general, and as yet I have no measurements from them. In connection with this difference of length of stamens may be mentioned the fact that the pollen sacs of the shorter ones uniformly burst open before those of the longer; also the remarkably large number of cases found in which the pollen was not developed at all, the flower being pistillate with rudimentary stamens. In these individuals the anthers were yellow, while the fertile anthers are a dark brown or brownish red. Further study will be made upon these points.

Authorities seem agreed that the fertile form of Erythronium is two-leaved. I have frequently found three-leaved plants in both E. Americanum and E. albidum; the third leaf appears later than the other two, pushing up into view while the plant is in bloom.

My experiments in cross fertilization have not yet been carried out sufficiently to warrant any conclusions in this regard.

With us E. albidum grows in very rich, wet soil in the low, well shaded parts of beech woods; E. Americanum is found in the drier soil near, but grows more abundantly in the dry soil of the high, open parts, seeming to prefer clay to the rich leaf mould.

I wish to express my indebtedness to Prof. Hicks and Prof. Wheeler, of Michigan Agricultural College, for literature on this subject. Also to Prof. McFarland, of Olivet College,

for the interest he has taken and the assistance he has so kindly given in the work.

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EXPLANATION OF PLATE XI.— Figs. 1–7, pistil of Erythronium Americanum; 5–7, pistil of E. albidum; 8, E. Americanum showing different length stamens; 9, corm of E. albidum; 10, stigma of E. Americanum, *a*, line of measurement, *d*, contracted part; 11, upper surface of stigma of E. albidum, *bc*, line of measurement; 12, cross-section of ovary of E. mesochoreum; 13, 14, cross-sections of ovary of E. albidum.

Noteworthy anatomical and physiological researches.

Anatomy of the tubers of Equisetum.

Leclerc du Sablon, describing the anatomy of these organs of *Equisetum*,[1] shows that they represent short branches reduced to a single internode. These tubers are situated upon the rhizome; they are able, when detached, to develop independent individuals. They are pear-shaped in *Equisetum Telmateja*, occurring in clusters of two or three at a node of the rhizome. A transverse section shows a very thin cuticle which has no incrustation of silica, and a starch-bearing parenchyma just inside the epidermis. This parenchyma entirely surrounds the central part of the tuber including the ring of fibro-vascular bundles. Each bundle is again surrounded by an endodermis, the radial walls of which show the spots named after Caspary. There is no lacune to be observed in the hadrome, which, in most cases is characteristic of the oldest part of the stem above ground in the *Equisetaceæ*; and the vessels are present in a still larger number in the tuber. These vessels are not arranged in any order, but scattered and intermixed with parenchymatic cells. The largest ones are not always situated in the outer part of the entire bundle, but are irregularly mixed with the smaller ones, and do not show the shape of a *V*, which characterizes the bundles of the stem. Towards the apex the bundles increase in number and unite to form a crown which corresponds to the terminal node of the tuber. Such anastomosing bundles are not known elsewhere in the internodes of the rhizomes of *Equisetaceæ*.

The most important character in the structure of these tubers, and by which they differ from the rhizome, are: The division of the endodermis into special endodermes, surround-

[1] Sur les tubercules des Equisétacées: Revue générale de Botanique, (1892.) no. 39.